TRAFFIC ENGINEERING DIVISION
MARICOPA COUNTY DEPARTMENT OF TRANSPORTATION

Policy/Procedure Guideline

SECTION 4: Traffic Signals

SUBJECT 4.4: Traffic Signal System Synchronization

EFFECTIVE DATE: 06/01/95

PARAGRAPH:
1. Purpose
2. Description
3. Exhibits
4. Background
5. Authorization
6. References
7. Attachments

1. PURPOSE:

To synchronize arterial traffic signals to permit drivers to pass through consecutive green lights.

2. DESCRIPTION:

A. The following factors determine if a street needs to be synchronized.

   1. Where there are three or more traffic signal on an arterial with adjacent spacing of 1/2 mile or less.

   2. Synchronization of the arterial will help regulate the vehicular speed on the street and provide gaps in the traffic flow so side street vehicles may enter the arterial .

B. The procedure for setting up a system synchronization timing plan is as follows:

   1. Ensure that the proposed timing at each intersection meets the requirements set forth in Section 4 (Traffic

Signals) Subject 4.2 (Isolated intersection Timing)of these Policy/Procedure Guidelines.

2. Establish the system limits,intersection spacing and posted speed limit to be considered.
3. Perform 24 hour(a minimum)directional counts on the arterial street at one or more locations (turning movement counts at intersections may also be necessary).
4. Perform a Time/Delay Study on the arterial during the AM and PM peak periods.
5. Determine the initial trial cycle length based on the desired arterial progression speed (at or below the posted limit)and the signal spacing. See the System Speed table in the Attachment for typical spacing, speed, and offset relationships. The cycle should approximate the longest required cycle for the "critical" intersection (most congested, most number of signal phases) in the system. Different cycles may be required for different time periods.
6. Determine the splits at each intersection based on the approximate ratios of existing green and clearance times per signal phase to the total cycle time.
7. Utilizing the signal synchronization program using "NOSTOP" by McTrans, optimizes the offsets at each intersection on the system. Adjust the cycle, offsets, speed, and phase splits to maximize the bandwidth (ratio of green through time to the smallest, arterial green time) and optimum efficiency(ratio of green through bound to the system cycle length)cycle.
8. Install timing scheme in the field (arterial master and each controller). Adjust local timing parameters as needed. Record all timings on field and office records.
9. Determine the period of day (Weekday and Weekend) to implement synchronization based on the desire to maximize arterial synchronization (minimize stops) and minimize intersection cross-street delays. Generally, no synchronization will be implemented on Saturdays or Sundays unless sufficient volumes are present. Synchronization schedules will be adjusted as arterial volumes change and based on citizen input.
10. Perform travel time and delay study. Record location and lengths of stops, adjust system timing parameters as needed. Produce written before/after system timing report.
11. Each year, perform follow-up travel time and delay study; adjust timings as needed. Document in memorandum form.

12. Systems to be installed shall be added to the Arterial Signal System Program annually.

3. EXHIBITS:

a. Traffic Signal Timing Sheet for Time Base Coordination.
b. Time/Delay Study Work sheet.
c. Time-Space Diagram
d. Arterial Signal System Program listing.

4. BACKGROUND:

When an arterial traffic signal system timing is properly designed, and maintained, it can provide the following benefits:

1. Reduce the frequency of certain types of accidents, especially the right angle and pedestrian types
2. Improve the traffic handling capacity of the intersections.
4. Reduce the delay to vehicular traffic using the intersections.
5. When coordinated with control devices at other intersections, they can provide for the continuous or nearly continuous movement of traffic at designated speed along a given route.

5. AUTHORIZATION:

a. 1989 Transportation Laws of Arizona, Section 28-643. Local traffic-control devices, Page 165.

28-643. Local Traffic-control devices.
Local authorities in their respective jurisdictions shall place and maintain such traffic-control devices upon highways under their jurisdiction as they deem necessary to indicate and to carry out the provisions of this chapter or local traffic ordinances or to regulate, warn or guide traffic. All traffic-control devices erected shall conform to the state manual and specifications.

6. REFERENCES:

a. The Manual of Uniform Traffic Control Devices Section 4, Responsibility for Traffic Control Devices.
b. The Manual on Signal Design (ITE)
c. The MCDOT Traffic Engineering Signal Design Manual
d. The NOSTOP Arterial Progression Analysis Software.
e. The TRANSYT-7F Network Progression Analysis Software.

f. The PROGO Progression Graphics and Optimization

7. ATTACHMENTS:

Not Applicable

Approved: _____

Albert G. Letzkus, P.E.
Traffic Engineer

Maricopa County Department of Transportation
Traffic Signal Timing Sheets:

Time Base Coordination

System Name:_____ Maintenance Number_____

System Intersections:

1._____ 6._____
2._____ 7._____
3._____ 8._____
4._____ 9._____
5._____ 10._____

Time of Day (hrs)	Day of Week (M-F)	Week of Year (1-52)	Cycle (sec)	Offset (%)	Split (%)	Free Oper.	Maximum Greens							
							Ø 1	Ø 2	Ø 3	Ø 4	Ø 5	Ø 6	Ø 7	Ø 8

Remarks:

TIME/DELAY RUNS

'REET: ______________________________ DATE:_____

:CTION:______________________________ DAY:_____

:RECTION: ______________________________ BY:_____

START TIME _____	START TIME _____	START TIME _____
TRAVEL TIME ____	TRAVEL TIME ____	TRAVEL TIME ____
TIME AT	**TIME AT**	**TIME AT**
1.______ ______________	1.______ ______________	1.______ ______________
2.______ ______________	2.______ ______________	2.______ ______________
3.______ ______________	3.______ ______________	3.______ ______________
4.______ ______________	4.______ ______________	4.______ ______________
5.______ ______________	5.______ ______________	5.______ ______________
6.______ ______________	6.______ ______________	6.______ ______________
7.______ ______________	7.______ ______________	7.______ ______________
8.______ ______________	8.______ ______________	8.______ ______________
9.______ ______________	9.______ ______________	9.______ ______________
10._____ ______________	10._____ ______________	10._____ ______________
STOP TIME ___________	**STOP TIME** ___________	**STOP TIME** ___________
TOTAL # STOPS ______	**TOTAL # STOPS** ______	**TOTAL # STOPS** ______

AVERAGE TRAVEL TIME PER RUN : __________ min.
AVERAGE STOP TIME PER RUN : ____________ min.
AVERAGE # STOPS PER RUN : _____________
LENGTH OF RUN : __________ miles
CALCULATED AVERAGE TRAVEL : __________ mph
CALCULATED AVERAGE % STOP TIME : _____________ %
CALCULATED AVERAGE # STOPS/MILE : ______________
AVERAGE TRAVEL TIME PER RUN: _______ min.
AVERAGE STOP TIME PER RUN: _____ min.
AVERAGE # STOPS PER RUN: _______
LENGTH OF RUN : _____ miles
CALCULATED AVERAGE TRAVEL : _______ mph
CALCULATED AVERAGE % STOP TIME : _______ %
CALCULATED AVERAGE # STOPS/MILE: _______

::TIM.SET

MCDOT Arterial Signal Systems Program

Map Ref. No.	System	Number of Signals	Work Order Number	*TBC Completion Date	Conversion to **CLS
1	Buckeye	2	87557	1992	
2	University	4	87550	1992	
3	Sun City	4	87569	April ,1977	
4	Sun City West	5	87558	July ,1993	Sept. ,1993
5	Sun Lakes	4	87562	May ,1993	
6	Luke	6	87554	Sept, 1993	***
7	Broadway	5	87551	Jan , 1994	***
8	West Bell	3	87552	Dec. ,1993	Nov. ,1994
9	East Bell	7	87559	Oct. ,1994	Feb. ,1995
10	Dreamland Villa	3	87568	Nov. ,1994	***
11	McDowell	4	87553	Feb. ,1994	April ,1995
12	Olive	5	87564	Feb. ,1994	
13	Thunderbird	3	87563	1995	***
14	MC 85	10	87560	1995	
15	Peoria	7	87565	1995	
16	Indian School	3	87561	1996	
17	Tolleson	4	87567	1996	
18	99th Ave. (South)	5	87555	1996	
19	Goodyear	5	87556	1996	

* Time Base Coordination
** Closed Loop (Hard Wired) System
*** Future Closed Loop System

06/30/93